

# **OPERATING MANUAL**

**Q-M MODEL 1-42**

## **LOW VOLTAGE CIRCUIT TESTER**

**Made for United States Government  
Ordnance Department**

**BY**

**HEYER PRODUCTS COMPANY  
INCORPORATED**

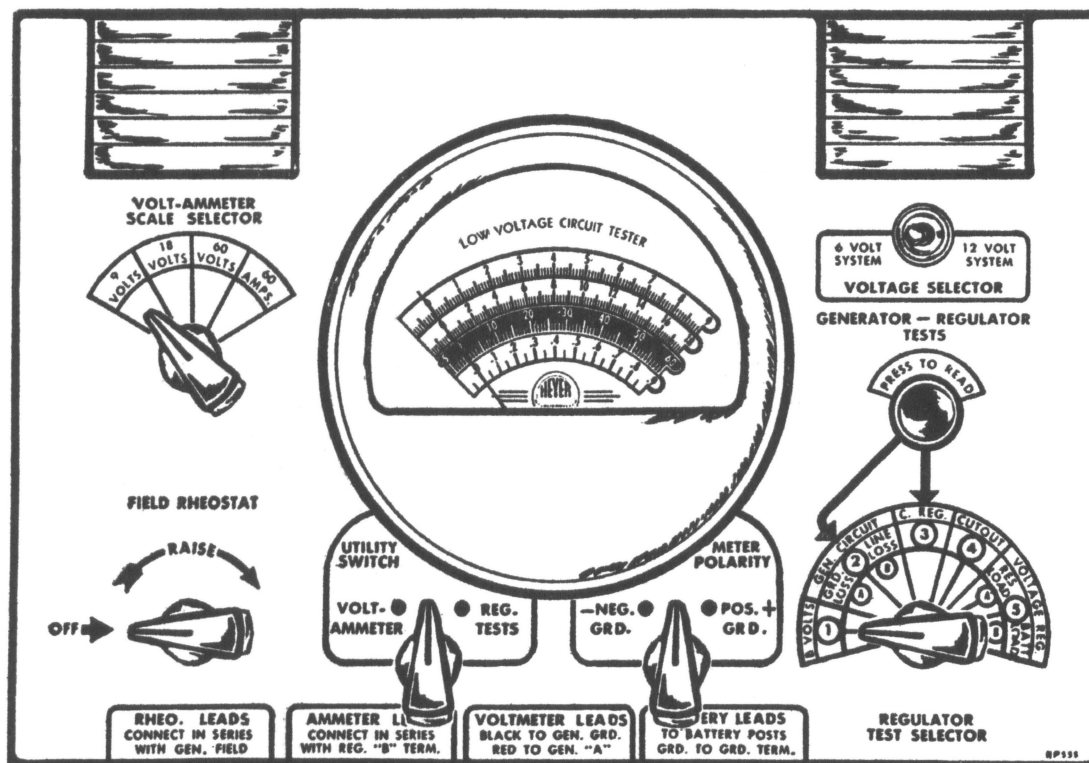
**BELLEVILLE, N. J.**

**U. S. A.**

To service or adjust any part of low voltage circuit system, always refer to **MAINTENANCE MANUAL** of vehicle being tested for all specifications or detailed instructions.

# LOW VOLTAGE CIRCUIT TESTER

## Q-M MODEL 1-42



## INTRODUCTION

The **Low Voltage Circuit Tester** is a self-contained trouble-shooting device for making a complete and rapid check of the generator-battery circuit, including any current and voltage regulators which may be used. Battery voltage, regulator and cut-out settings, and generator performance can all be easily determined.

The Tester is so constructed that all the connections must be made before any tests are attempted. Then by moving the selectors and switches in the order specified on the **Operating Instruction Plate**, the condition of the whole generator-battery circuit is readily observed.

If any meter readings for a particular test are unusual or are not within the range specified on the **Operating Instruction Plate**, then refer to the discussion concerning that test which is contained in this **Operating Manual**. Here in this Manual the ranges specified on the instruction plate are given in more detail. Suggestions are also given as to what may be causing the trouble and how it can be corrected.

## Generator-Regulator Test Connections

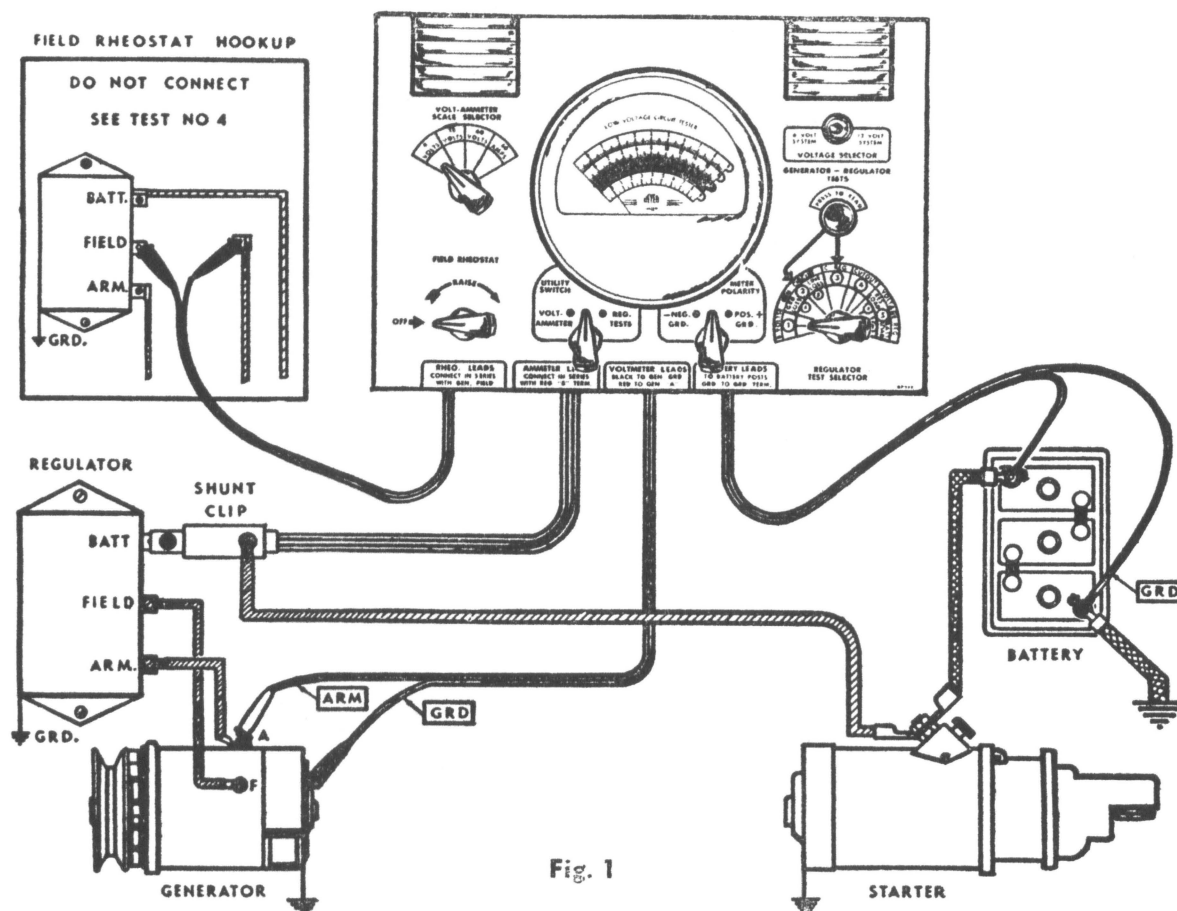


Fig. 1

## Generator-Regulator Test Connections

Diagram above shows the necessary connections to test the complete generator-regulator circuit. Make all connections shown in Fig. 1 except those for Field Rheostat Hookup. Use Field Rheostat Hookup only if necessary in test No. 4.

1. Place the knob of the VOLTAGE SELECTOR SWITCH to correspond with the voltage of the system being tested. (6 or 12 volts).
2. Place UTILITY SWITCH to the REGULATOR TEST position.
3. Place METER POLARITY SWITCH to suit ground polarity of vehicle.
4. Place switch marked REGULATOR TEST SELECTOR to No. 1 position.
5. Disconnect the wire from terminal of the regulator marked "B" and connect the shunt clip to this terminal.
6. Connect the wire just removed to end terminal of the shunt clip. THIS IS IMPORTANT as the shunt

must be in **series** with the circuit to be tested. This clip contains a built-in meter shunt to which the tester is calibrated.

7. Connect VOLTMETER test lead tagged "ARM" to armature terminal of the generator, and the lead tagged "GRD" to generator frame (oil cup) as shown above.
8. The connections shown on the battery must be made by driving the pins into the battery posts, lead marked "GRD" to the ground post. Drive pins into center of posts.

*All tests must be made with engine warm, about 145° and with regulator cover in place.*

**NOTE:** To check low voltage circuit on vehicles equipped with Delco-Remy No. 5628 and Autolite VRY voltage regulators the following procedure should be employed. For all other types of regulators or vehicles not equipped with regulators see section 2A of the manual.

## TEST No. 1

### BATTERY TEST—Fig. 2

This test is a check on the condition of the battery using the **starter as a load**. A defective or undercharged battery may cause misleading readings on the voltage regulator tests.

*Regulator Test Selector Switch must be in No. 1 Position.*

Operate the starter with ignition off.

With starter cranking the engine, the voltage should not drop below **5.25 volts on 6 volt systems** (read **yellow** scale) or **10.5 volts on 12 volt systems** (read the **red** scale).

If the voltage drops below 5.25 volts, check the gravity of the electrolyte in each cell. A variation of more than 20 points between cells denotes a defective battery.

If the gravity of all cells are alike, but below 1.270, a partially charged battery is indicated. The low gravity may be caused by improper adjustment of the regulator which will be determined on the tests which are to follow.

If either of these conditions exist, it is best to replace it with a fully charged good battery for the following tests.

A voltage reading below 4.5 volts with the starter cranking the engine usually indicates a discharged or defective battery.

A worn starter in which the armature is dragging on the fields will put an excessive load on the battery and cause excessive voltage drop.

If voltage is normal but starter does not turn freely examine battery terminals and connections, starter switch and starter.

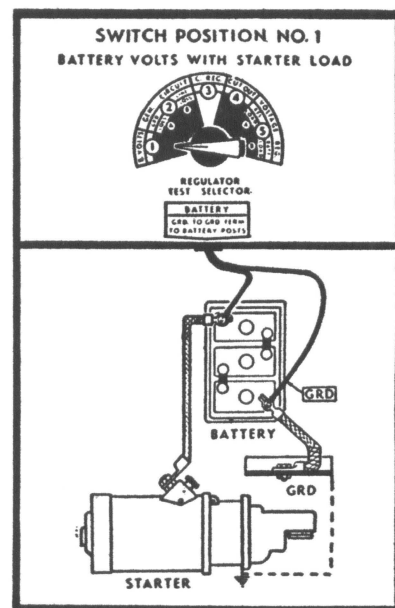


Fig. 2

## TEST No. 2

### VOLTAGE LOSS IN GENERATOR-BATTERY GROUND CIRCUIT—Fig. 3

*Place Regulator Test Selector Switch in No. 2A position.*

Run engine at about 2,000 RPM (approx. half speed), then **press black push button**.

The meter reading should not exceed **.05 volt** (one division) on the **green** scale if the ground circuit is in good condition. A reading higher than this indicates a loss of voltage due to bad ground connections.

*Loss of voltage may be traced to one of the following causes:*

1. Bad contact of generator housing to engine due to grease, paint, or rust.
2. Ground strap from battery to frame in bad condition or loose.
3. Ground from engine to frame in bad condition or loose.
4. Connection of ground strap on battery badly corroded, or not tight.

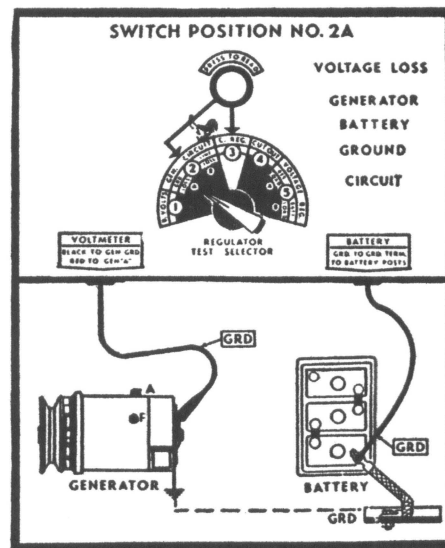


Fig. 3



## TEST No. 2—Continued

### VOLTAGE LOSS IN REGULATOR GROUND—Fig. 4

*Regulator Test Selector Switch remains in No. 2A position, engine running.*

Disconnect the voltmeter "GRD" test cable which is connected to the generator frame and connect it to the regulator frame and again **press the black button**.

Reading should not exceed **.05 volt** (1 div. **green** scale). A higher reading indicates loss in the regulator ground circuit.

Losses in this circuit are caused by bad grounding of the regulator frame to chassis due to loose mounting bolts, rust, paint or grease under regulator bolting lugs.

*After completing this test, leave "GRD" cable in this position for all following tests.*

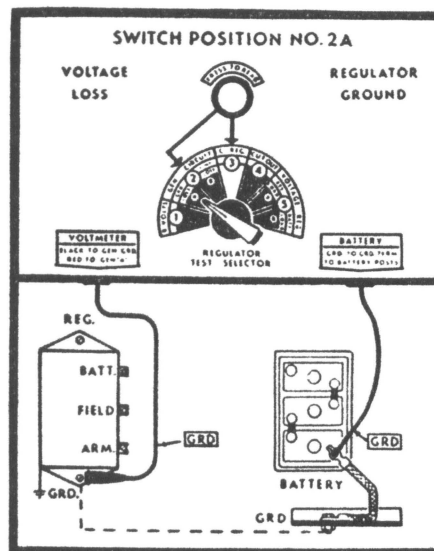


Fig. 4

### VOLTAGE LOSS IN CHARGING CIRCUIT—Fig. 5

*Place Regulator Test Selector Switch in No. 2B position, engine running.*

**Press the black button** and note voltage loss on the **yellow** scale.

If battery is under the hood, maximum loss should not exceed **1 volt**, if elsewhere, **1.5 volts**.

Excessive voltage drop indicates defective cables or loose connections in the circuit between the generator and battery, or it may be caused by defects or high resistance in the dashboard ammeter.

Undersize cables will also cause excessive voltage loss.

Bad connections inside of the regulator may also cause excessive loss.

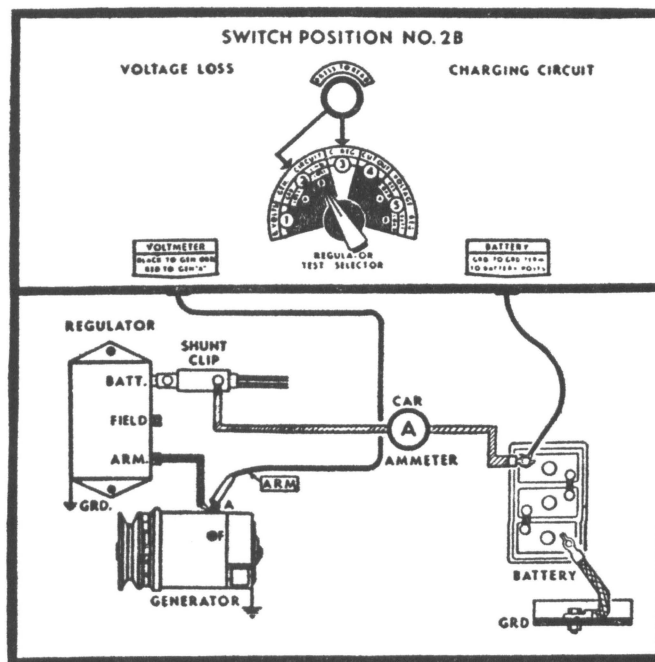


Fig. 5

### Test No. 3

**CURRENT REGULATOR TESTS—(3 unit types) Fig. 6**  
Set the "Regulator Test Selector Switch" to No. 3 position.

Run engine at about 2,000 RPM as on the previous test and **press the black button**. Note charging rate (amperes) on **black scale**.

*Charging current should then be equal to the rated capacity of the generator (see rating plate on regulator).*

If charging current is higher or lower than capacity of generator, current regulator is incorrectly set.

*When adjustment is found to be necessary, adjust as follows:*

#### AUTO-LITE VRY TYPES

Current setting may be adjusted by changing the tension of the spiral armature spring of current regulator. To change the tension turn the screw on the lower end of the spring.

#### DELCO-REMY No. 5628 REGULATOR

To adjust, loosen lock screw and adjust eccentric screw which changes tension of spiral spring on current regulator. After completing the adjustment, again tighten the lock screw.

#### 2-UNIT REGULATORS ONLY

Current regulation is determined as follows:

1. Connect short jumper lead from generator **Field** to **Ground**. (On Fords, from **Field** to **Arm.**)
2. Increase engine speed to point where maximum charging rate is obtained. Read on **black scale**.

*Charging current should not exceed rated capacity of generator.*

#### NON-REGULATED SYSTEMS—(Cut-out relay only)

Current regulation is determined as follows:

1. Connect **shunt clip** to **Bat.** terminal of cut-out relay, after removing "Battery" Lead from that terminal. *Make sure that vehicle "battery" lead is connected to end terminal of shunt clip.*
2. Increase engine speed from a slow idle to the point where maximum charging rate is obtained. Read on **black scale**.

*Charging current should correspond with rated capacity of generator.*

Charging current may be adjusted by moving the third brush in the direction of armature rotation to increase the current, in the reverse direction to decrease current.

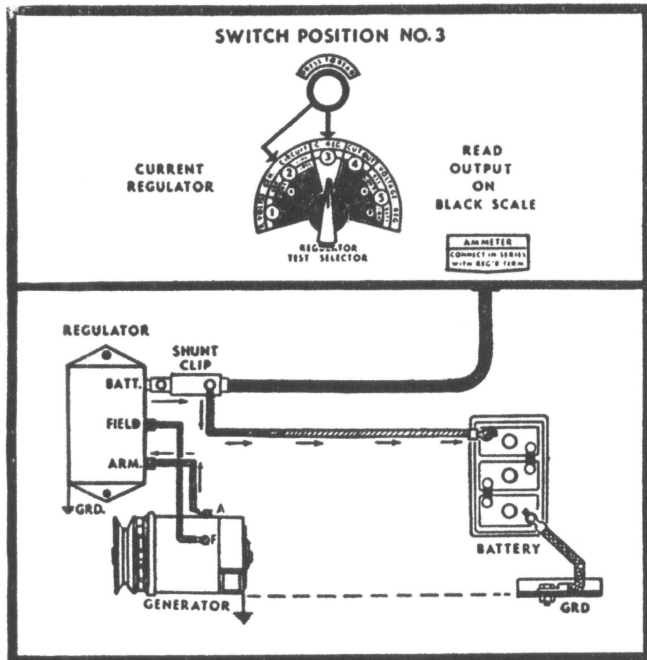


Fig. 6

### TEST No. 4—CUT-OUT RELAY

#### REVERSE CURRENT—Fig. 6

Leave Regulator Test Selector in No. 3 position.

Gradually reduce engine speed and note reverse current on the **black scale**. If the cut-out relay is opening properly this reverse **current should not exceed 5 amps.** before the points open and reverse current stops. Some times it may be necessary to "cut the engine off" to read the discharge current as the engine slows down to a stop.

#### CLOSING VOLTAGE—Fig. 7

After the above test place the "Regulator Test Selector Switch" in No. 4 position.

Idle engine, then gradually increase speed and observe voltage at which cut-out closes. **This will be indicated by meter pointer dropping back slightly** at the moment the cut-out points close. Sometimes a click can be heard when the points close.

Cut-out closing voltage should always be **above** that of the battery and at least **.5 volt under** voltage setting of regulator.

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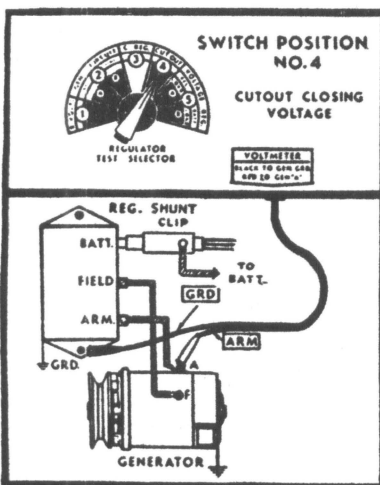


Fig. 7

## TEST No. 4—Continued

*Closing voltage of the cut-out relay may be adjusted as described below:*

### AUTO-LITE VRY TYPES

Adjust by adjusting screw at lower end of the spiral armature spring of the generator cut-out.

### DELCO-REMY HEAVY DUTY TYPES

Adjust by loosening lock screw and adjusting eccentric of the generator cut-out.  
Tighten lock screw after completing the adjustment.

### FIELD RHEOSTAT—Fig. 8

*All other connections same as in Fig. 7.*

Some generators charge at idle speeds so that the closing voltage of the cut-out cannot be determined by ordinary methods. A field rheostat is provided for controlling the voltage of generators at idling speed to check cut-out closing voltage. Connect this rheostat in **series** with the field terminal of the generator at the regulator as shown in Fig. 8. Maintain engine speed at fast idle then gradually increase generator output with FIELD

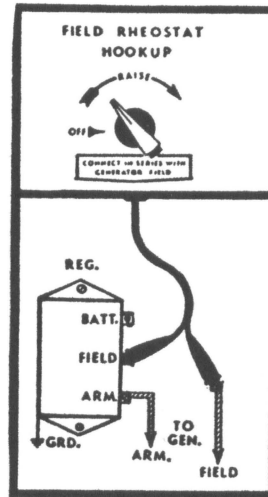


Fig. 8

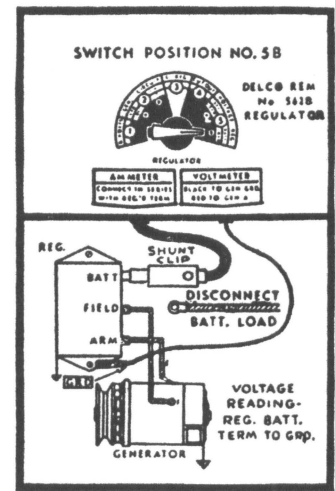


Fig. 10

RHEOSTAT by rotating knob in the direction of arrow until meter pointer kicks back slightly. This indicates closing voltage.

## TEST No. 5

### VOLTAGE REGULATOR TEST "RESISTANCE LOAD"

Fig. 9

#### AUTO-LITE VRY REGULATOR

*Set the Regulator Test Selector in No. 5A position.*

Disconnect the battery lead from the end of shunt clip and place it in some position where it will not spark or become grounded.

Run engine at about 2,000 RPM for about 5 minutes to permit the voltage to stabilize, and note exact point at which regulator limits the voltage. Reading the **yellow** scale for 6 volt systems or the **red** scale for 12 volt systems.

#### DELCO-REMY No. 5628 REGULATOR—Fig. 10

This regulator **must** be tested and adjusted on **open circuit**. The resistance load is not used.

*To set the regulator on open circuit place Regulator Test Selector in No. 5B position.*

Disconnect the battery lead from the end of shunt clip and place it in some position where it will not spark or become grounded.

Run engine at about 2,000 RPM for approx. 5 minutes to permit the voltage to stabilize, and note exact point at which regulator limits the voltage. Reading the **yellow** scale for 6 volt systems or the **red** scale for 12 volt systems.

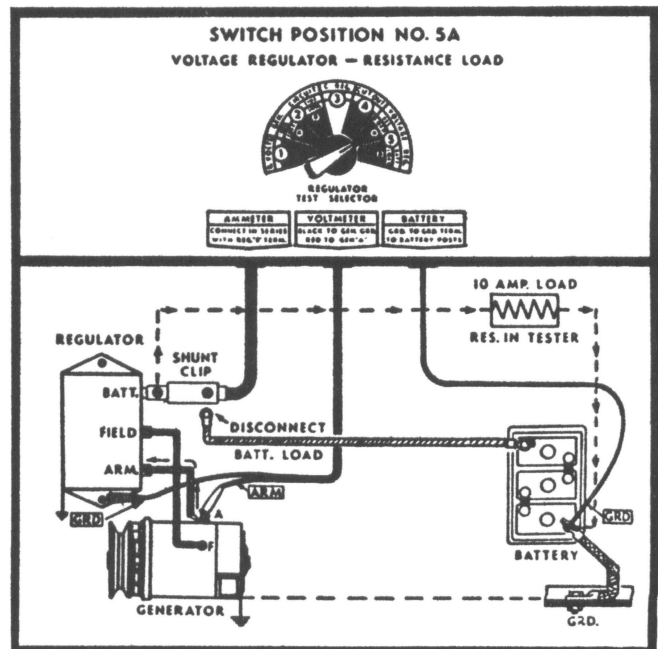


Fig. 9

High voltage settings will cause excessive charging rates which may be harmful to the battery. Low voltage settings will cause low charging rates which will not keep the battery charged.

## TEST No. 5—Continued

### ADJUSTING VOLTAGE SETTINGS

The voltage setting of the regulator may be adjusted by changing the spring tension of the spiral armature spring of voltage regulator.

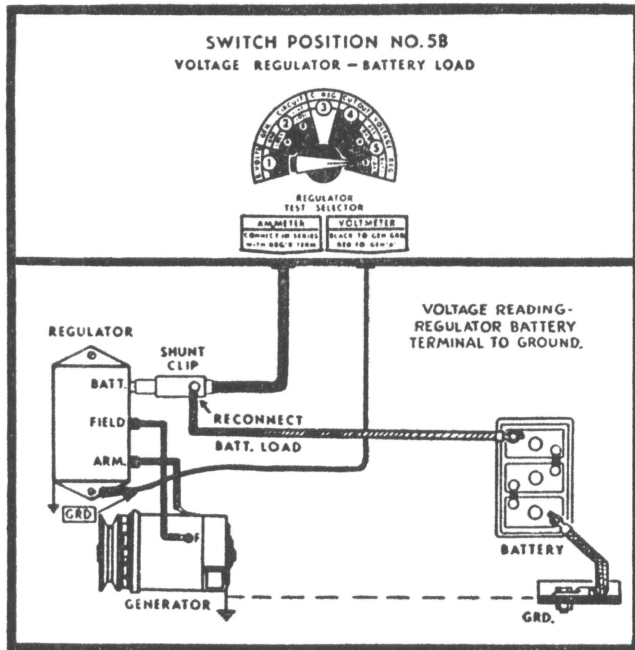


Fig. 11

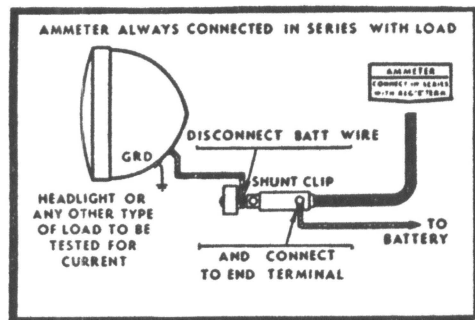


Fig. 12

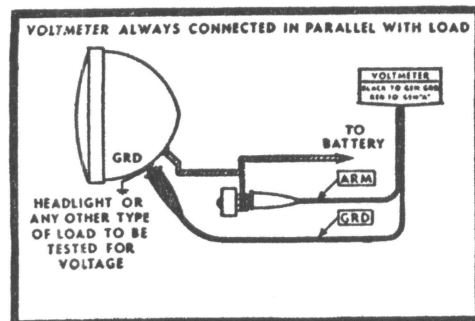


Fig. 13

On the **Auto-Lite VRY** type regulators the spring tension is adjusted by turning the thumb screw on the bottom end of the spiral spring of voltage regulator.

On the **Delco-Remy No. 5628** regulator, the spring tension is adjusted by loosening the lock screw and turning the eccentric of the voltage regulator.

NOTE: If the regulator adjustment is set below the closing voltage of the cut-out relay, it will prevent the cut-out relay from closing. If this happens accidentally, bridge the voltage regulator contacts with a jumper lead temporarily so there will be no voltage regulation. This will permit the generator to build up sufficient voltage to close the cut-out relay contacts.

### VOLTAGE REGULATOR TEST "BATTERY LOAD"—

Fig. 11

Set the Regulator Test Selector in No. 5B position.

Reconnect battery lead to end terminal of shunt clip.

Run the engine at about 2,000 RPM for approx. five minutes, and note voltage reading on the **yellow** scale for 6 volt systems, **red** scale for 12 volt systems. On 6 volt systems, this voltage should be 6.5 to 7.6 volts.

This is the final test on the regulator operating in the electrical system with battery and car wiring in the circuit. **No further adjustments should be attempted.**

The charging current will vary due to changing characteristics of the electrical system and the voltage will vary between the limits given above.

This completes the tests and all test leads should be disconnected. Be sure all connections on the regulator are tight.

## VOLT-AMMETER TESTS

1. Place VOLTAGE SELECTOR to suit voltage of vehicle system.
2. Place UTILITY SWITCH at Volt-Ammeter position.
3. Place METER POLARITY Switch to suit ground polarity of vehicle
4. Place VOLT-AMMETER SCALE SELECTOR at desired meter range.
5. Use AMMETER leads to measure CURRENT (amperes) placing the SHUNT CLIP in Series with the circuit to be tested (not to exceed 60 amperes).—Fig. 12.
6. Use VOLTMETER leads to measure VOLTAGE making connections always PARALLEL to the circuit to be tested. Fig. 13.

VOLT-AMMETER IS NOW AVAILABLE FOR OTHER LOW VOLTAGE SYSTEM TESTS WITHIN THE RANGE OF METER.

## SECTION 2A

### TYPES OF REGULATORS

#### THREE UNIT TYPES

The three unit regulator consists of a **cut-out relay, voltage regulator, and current regulator** mounted in one control box. These regulators are used with the two or four brush shunt type generators.

The purpose of each of the three units is as follows:

THE CUT-OUT RELAY disconnects the generator from the battery when the generator stops charging or its voltage drops below that of the battery. This is to prevent the battery from discharging through the generator.

THE VOLTAGE REGULATOR controls the charging rate of the generator and maintains a rate which meets the load requirements on the electrical system and holds the voltage to correct limits.

THE CURRENT REGULATOR limits the maximum output of the generator to that for which it was designed and prevents the charging rate from exceeding a safe value under any conditions. The current regulator is used only with the **two or four brush** shunt type generator. The advantage of the two brush generator is its higher current output at lower speeds, and it does not have the taper-off at high speeds characteristic of the three brush generator which requires no external current regulator.

In checking the low voltage circuit on vehicles equipped with a (three) unit type of regulator the procedure given in this operating manual should be followed in its entirety.

*See Maintenance Manual of vehicle being tested for all specifications of this type of regulator.*

#### TWO UNIT TYPES

The two unit regulator consists of a cut-out relay and voltage regulator only. This regulator is **used with a 3 brush type generator only**. The current regulator is not incorporated in this unit. In the three brush type generators the output is limited to a safe value by the action of the third brush which is adjustable.

In checking the low voltage circuit on vehicles equipped with a two unit type of regulator the same procedure applies except where an alternate procedure is indicated as in Test No. 3.

*See Maintenance Manual of vehicle being tested for all specifications of this type of regulator.*

#### NON-REGULATED SYSTEMS

On the non-regulated generators only a cut-out relay is used. The generator output is only partially controlled and can be changed manually by shifting the position of the third brush which is adjustable and controls the charging rate.

Unless the battery gravity is regularly checked and the third brush is adjusted to meet the requirements of the electrical system, the battery may not receive sufficient charge, or it may be overcharged, resulting in high voltage.

In checking the low voltage circuit on vehicles equipped with cut-out relay only, the same procedure applies except where an alternate procedure is indicated as in Test No. 3. Tests No. 5 are eliminated entirely.

*See Maintenance Manual of vehicle being tested for all specifications on this unit.*

## Replacement Parts List

Stock No. 17-T-5575

### LOW VOLTAGE CIRCUIT TESTER Q-M MODEL 1-42

MADE FOR U. S. ARMY—Q-M

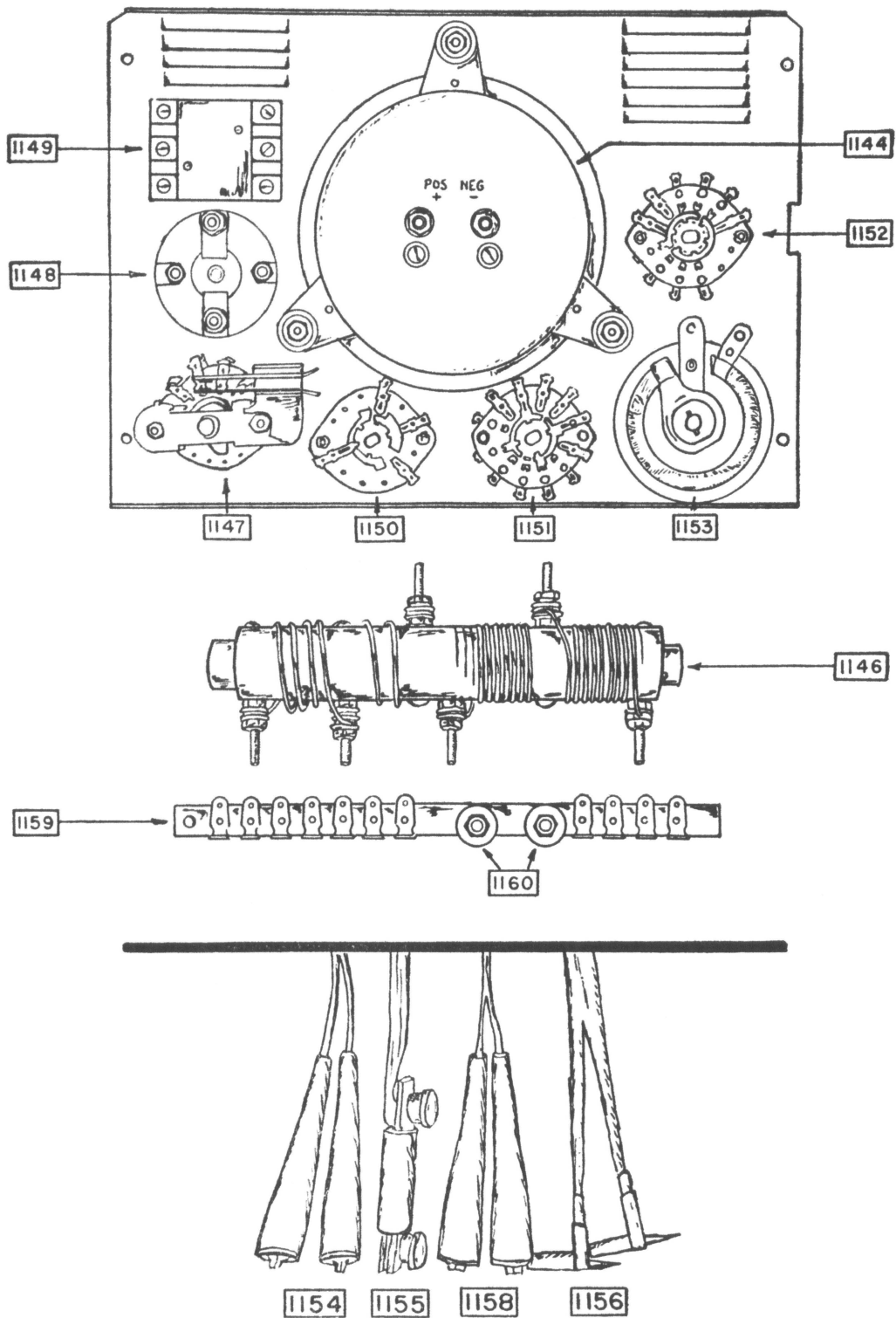
<i>Part No.</i>	<i>Description</i>	<i>Price</i>
1141	Operating Manual.....	\$1.00
1142	Operating Instruction Plate (Incl. Mounting Screws) .....	1.25
1143	Metal Carrying Case Complete.....	6.50
1144	Meter Complete.....	16.50
1146	Multisection Load Resistor.....	3.50
1147	Regulator Test Selector Switch Assembly.....	4.40
1148	Push Button Switch (Incl. Screws and Nuts for Mounting) .....	1.50
1149	Voltage Selector (3 Circuit Toggle Switch) .....	3.30
1150	Meter Polarity Switch.....	1.50
1151	Utility Switch.....	1.50
1152	Volt-Ammeter Scale Selector Switch.....	1.50
1153	Field Rheostat.....	4.00
1154	Voltmeter Leads with Clips and Rubber Insulators Complete..... (Set of 2)	1.40
1155	Ammeter Lead (3 Wire) Complete with Calibrated Shunt.....	3.50
1156	Battery Leads with Drive-in Connectors Complete..... (Set of 2)	2.00
1157	Drive-in Connectors Only..... (Set of 2)	.70
1158	Field Rheostat Leads with Clips and Rubber Insulators Complete.....	1.25
1159	Terminal Panel with Insulator (Incl. Screws and Nuts for Mounting) .....	.75
1160	Meter Multipliers..... (Set of 4)	2.50
1161	Moulded Knob for Calibrated Shunt..... (2 Required) each	.25
5011	Moulded Switch Bar Knob..... (5 Required) each	.10

The prices shown are F.O.B. Belleville, N. J., U.S.A.  
and cover domestic packing only.

Always specify "SERIAL" number of the equipment for which the part is intended.  
Should a part be required that is not listed above, order by description.

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# PARTS DIAGRAM





# SCHEMATIC WIRING DIAGRAM

## LOW VOLTAGE CIRCUIT TESTER—Q-M MODEL 1-42

